



Seabird Monitoring & Research Project Isles of Scilly 2021



Using a drone to survey lesser black-backed gulls on Gugh. Photo: Scott Reid

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Funded by the Isles of Scilly Area of Outstanding Natural Beauty

Summary of Seabird Monitoring and Research 2021

Monitoring of seabird numbers and productivity on St Agnes and Gugh

- Manx shearwater
 - breeding population has increased from 22 pairs in 2013 (pre rat eradication) to at least 82 pairs in 2021 (post rat eradication), with further sub-colony site expansions
 - response rate calibration survey conducted for 52 active burrows over 5 consecutive days in June – analysis suggests calibration factor used is too low and our number of breeding pairs on St Agnes & Gugh may be considerably higher
 - 55 'star-gazing' chicks recorded (28 St Agnes, 27 Gugh); none recorded pre-rat eradication
 - no fledging recorded at sub-colonies on Bryher or Peninnis, St Mary's, both of which have rat presence
- Storm petrel
 - recorded breeding successfully again on St Agnes & Gugh (first records 2015) including a new area on St Agnes in boulders at Pedney Brow, Wingletang
 - continued cat predation (first recorded 2019); minimum 17 adult birds predated over 3 sites (Troytown on St Agnes, Burnt Island & Gugh)
 - 11 calling chicks recorded (7 on Gugh, 4 St Agnes)
- Lesser black-backed gull
 - colony on Gugh 397 pairs (875 in 2006, but regularly at around 400 since 2012)
 - drone surveys trialled on Gugh and Samson for both breeding pairs and fledging chicks – initial results promising
 - productivity higher than in previous years, est. 0.94 to 0.88 chicks per pair
- Oystercatcher
 - increase in nesting pairs with 15 nests on Gugh and 8 on St Agnes

Productivity monitoring work across the archipelago

- Herring gulls: selected sub-colonies on Samson and in Hugh Town, St Mary's
 - productivity 0.41 chicks per pair on Samson (n = 32)
 - productivity 1.65 chicks per pair in Hugh Town rooftop sub-colony (n = 17)
- Kittiwakes: all sub-colonies
 - showed a brief interest on the east side of Gugh but no recorded nesting attempts
- Fulmars: selected sub-colonies Menawethan (n = 43) and Daymark, St Martin's (n = 46)
 - productivity good, ranging from 0.40 to 0.54 chicks per pair

- Common terns: all sub-colonies
 - 18 pairs laid on the south end of Annet in mid to late June (generally mid-May in UK); 3 fledglings recorded in mid-August (min 0.17 chicks per pair)

Population monitoring work on Annet

- Puffins – 45 birds recorded (50 in 2006, 31 in 2015, 42 in 2019) – relatively stable
- Storm petrel – southern study beach not counted due to late breeding terns; good numbers recorded at alternative study area
- Sample area surveyed for Manx shearwaters with 29 AOBs recorded (stable)
- Shag and greater black-backed gull numbers stable (106 & 184 pairs respectively)

Introduction

Birds are widely accepted as excellent indicators of environmental health; their changing populations often provide clues to the overall health of their habitat. Measurement of population and productivity variables over time in a systematic way informs management priorities and actions for maintaining and recovering our seabird populations. The need for robust population census and monitoring is ever more pressing as anthropogenic impacts intensify (Croxall *et al.* 2012).

Monitoring seabirds can be challenging; they spend much of their lives at sea and often breed on hard to access rocks, cliffs and islets. Additionally, the nests maybe concealed by vegetation or be underground. As a result, monitoring can be expensive in terms of time and money and can bring with it access and disturbance challenges.

This is true in Scilly, with many birds nesting out on the Norrard and Western Rocks which need extremely calm seas and a good skipper to access. Two of the key species here are nocturnal burrow nesters (Manx shearwater and storm petrel) whilst our auks don't nest on external cliffs, but in crevices under boulders. Large gull colonies are also hard to count without setting off whole colony alarm and defence behaviour.

However, effective monitoring is essential to understanding long-term population trends and dynamics so that appropriate conservation action can be implemented (Walsh *et al.* 1995). Analysis of population change over time can promote understanding of the underlying factors behind trends and be used to influence decision making (Furness & Greenwood 1993).

As apex predators that feed on prey from a wide range of trophic levels, seabirds are not only key qualitative indicators of the world's largest biome, they are also among the most threatened vertebrates in the world, particularly burrow nesters. As numbers decline it makes it even more important that we monitor populations and try to understand what is happening.

Isles of Scilly Seabird Heritage & Data set

The full Special Protection Area (SPA) count conducted in 2015/16 confirmed Scilly as supporting a greater diversity of seabirds than any other site in England, with over 8,000 pairs of 13 species of regularly breeding seabird. Seabirds are a named feature in the SPA and many of the SSSI designations for the area and are a vitally important part of our Natural Heritage. We have:

- Internationally important numbers of lesser black-backed gull and storm petrel;
- Nationally important numbers of great black-backed gull (probably the largest colony in the UK), Manx shearwater and shag (possibly the largest colony in the UK);
- Regionally important numbers of puffin, razorbill, common tern and fulmar;
- One of only two sites in England where Manx shearwater and storm petrel breed (the other being Lundy).

Scilly's seabird breeding records comprise one of the best long-term environmental data sets we have for the islands. Detailed all-island counts were first conducted in 1970, with records of

numbers breeding on Annet being recorded annually since 2006, and for St Agnes and Gugh since 2012. Sadly, these records have documented alarming declines in many of our seabird populations. The overall number of breeding seabird pairs have declined by 9.8% since 2006 and by 31.3% since 1983. Furthermore, numbers of five species of seabird have declined across Scilly by more than 20% since 2006 (kittiwake 89%; common tern 65%; lesser black-backed gull 26%; herring gull 22%; shag 21%). These declines in the seabird populations of Scilly show that there is a clear need to take action.

The data collected in Scilly also contributes to national seabird records and allows comparison between different regional populations.

The scope of this report

Since the full SPA survey in 2006, annual productivity data for key seabird species have been collected at key sites across the islands. This is building up a picture of breeding successes and failures to add to the picture in the interim periods between full counts, and helping us to get an idea of the causes of the major species trends observed. Productivity for the species recorded here were collected using standard methods as set out in *The Seabird Monitoring Handbook* (Walsh *et al.* 1995). This report summarises the results of this seabird fieldwork conducted between April and September 2021 and was undertaken by the Isles of Scilly Wildlife Trust, funded by the Isles of Scilly Area of Outstanding Natural Beauty.

Results: Monitoring of seabird numbers and productivity on St Agnes and Gugh

A full survey of all seabird species breeding on St Agnes and Gugh has been conducted annually since 2012 with the results from this and the two previous SPA counts included in Tables 1 and 2 below. Over this period the number of both herring and lesser black-backed gulls has decreased. Kittiwakes first bred on St Agnes at the Turks Head in 2009 following the desertion of a number of sub-colonies elsewhere in the archipelago. After two years of failure at this site a small number of birds returned to breed at their former site on the eastern side of Gugh. The largest change since the removal of rats in the winter of 2013/14 has been the increase in breeding numbers, productivity and range of Manx shearwaters and the first recording in living memory of storm petrels breeding, now annually, on St Agnes since 2015 and on Gugh since 2016.

The results for St Agnes also suggest that fulmars may be a beneficiary of rat removal, with numbers increasing from 2 to 9 pairs post eradication. However, no concurrent increase in breeding numbers has been seen on Gugh. It should be possible in 2022 to record productivity for the fulmars on St Agnes and compare this to results from the other sub-colonies studied in the East of the archipelago where rats are present.

Table 1. Breeding seabirds on St Agnes (SH – shag; GBBG – great black-backed gull; LBBG – lesser black-backed gull; HG – herring gull; RAZ – razorbill; FUL – fulmar; KIT – kittiwake; COT – common tern; SP – storm petrel; MX – Manx shearwater; PUF – puffin; OYC – oystercatcher; RPL – ringed plover)

	FUL	MX	SH	LBBG	HG	GBBG	KIT	COT	SP	RPL	OYC	Total
2000	0	5	0	2	25	0	0	3	0	-	-	35
2006	0	8	0	0	15	1	0	0	0	-	-	24
2012	0	8	0	8	61	0	24	0	-	2	9	112
2013	2	5	0	8	32	0	38	0	0	1	8	94
Rat Removal												
2014	3	9	0	16	27	1	62	0	0	1	10	129
2015	4	12	0	14	11	1	75	0	6	1	7	131
2016	6	22	0	15	12	1	5	0	9	2	8	80
2017	8	23	0	1	7	0	0	0	11	2	10	62
2018	5	23	0	2	7	0	0	0	8	1	7	53
2019	6	27	0	1	8	0	0	0	2	0	6	50
2020	No count											
2021	9	36	0	0	6	0	0	0	6	1	8	66

Counts do not include Burnt Island and Tins Walbert (connected to St Agnes at low tide); storm petrel counts relate to only a sample of potential habitat surveyed.

Table 2. Breeding seabirds on Gugh

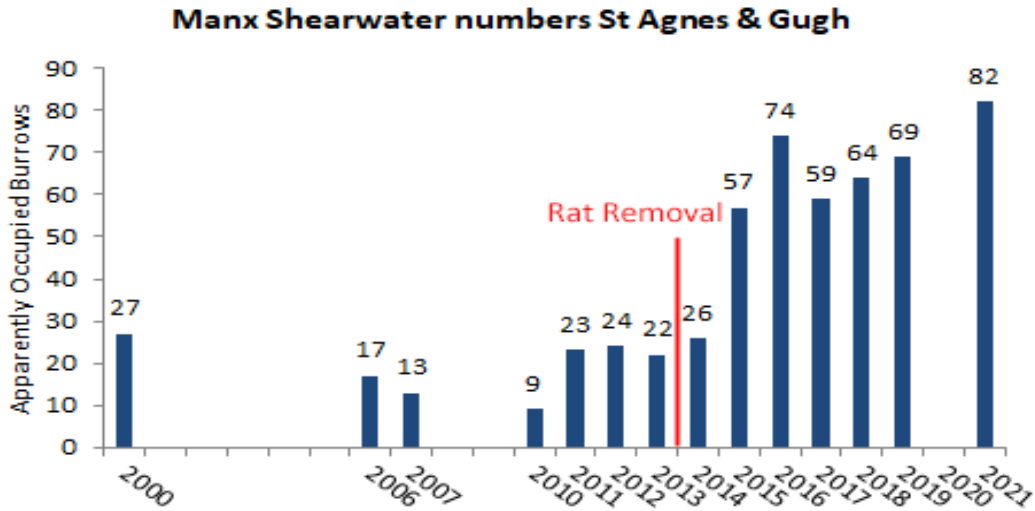
	FUL	MX	SH	LBBG	HG	GBBG	KIT	COT	SP	RPI	OYC	Total
2000	2	22	0	1123	159	3	155	0	0	-	-	1464
2006	3	9	0	875	69	4	131	0	0	-	-	1091
2012	4	16	2	361	53	10	0	0	-	0	7	453
2013	1	17	0	418	51	7	0	0	0	0	10	504
Rat Removal												
2014	5	17	0	411	30	5	0	0	0	0	10	478
2015	1	45	0	419	30	6	0	0	2	1	5	509
2016	1	52	0	400	36	5	0	0	4	0	10	508
2017	3	36	2	296	20	2	30	0	5	0	9	403
2018	2	41	0	452	28	0	35	0	11	1	9	579
2019	2	42	1	422	14	3	20	0	11	0	9	524
2020	No count						15	No count				
2021	3	46	0	397	22	2	0	0	7	0	15	492

Storm petrel counts relate to only a sample of potential habitat surveyed.

Manx shearwater settlement and productivity

[2015/16 full SPA count: 523 AOBs on 10 islands, 3-fold increase since 2006; Birds of Conservation Concern (BOCC) Amber Listed]

The numbers of apparently occupied Manx shearwater burrows on both St Agnes and Gugh have increased dramatically since the removal of rats in the winter of 2013-4 (islands officially declared 'rat free' in February 2016). In addition to the increase in breeding numbers, new burrows are being occupied year on year, with the sub-colony on Wingletang Down expanding inland since 2019 (see map below).



Distribution of active Manx shearwater burrows on St Agnes and Gugh in 2021

Response Rate Calibration survey

Since the Seabird 2000 census in Scilly, we have used the diurnal tape playback census method, following the Seabird Monitoring Handbook (Walsh *et al.* 1995), to record the number of Apparently Occupied Burrows. This method includes the use of a correction factor to account for the number of breeding birds that do not reply to the recording. Researchers have found that this conversion factor can vary between colonies and between years, so that employing a site and survey specific correction factor is preferable wherever possible.

For all Manx shearwater surveys in Scilly to date we have used the correction factor of 1.08 (based on a response rate of 0.93) as recommended in Newton (2004). However, a quick review of the literature suggests that this response rate is about half of that found in many of the most recent UK shearwater surveys. For example, calibration trials on c.100 burrows over 7-10 days on Lundy in 2017 and 2018 obtained correction factors of 2.558 and 2.000 respectively (Booker *et al.* 2019).

With the increase in number of occupied burrows on St Agnes and Gugh since rat removal, it is now within the realms of possibility to conduct a count specific calibration plot survey. In 2021, over 5 consecutive days from 2nd – 6th June, I conducted tape playback daily at 104 potentially occupied burrows across the two islands. Over the 5 days replies were heard from 52 of the burrows on at least one occasion. Recent work to standardise the analysis of playback survey data, has resulted in the development of a new *Shiny app* to help generate estimates of population size. This can be used by researchers to calculate the average response rate by implementing a series of R scripts (Bolton, Padgett & Wood *in prep.*) I was able to input the 2021 data into the app and obtained a response rate of between 0.38 and 0.62 across the two islands. This is considerably lower than the figure of 0.93, which the currently used correction factor is based on, and suggests that the number of occupied shearwater burrows on St Agnes & Gugh may easily be double what we have recorded. It will be important to repeat this response rate calibration survey in 2022 and further review the figures, particularly in time for the next all islands (full SPA) survey.



Ranger Rhianna conducting diurnal playback response survey St Agnes.

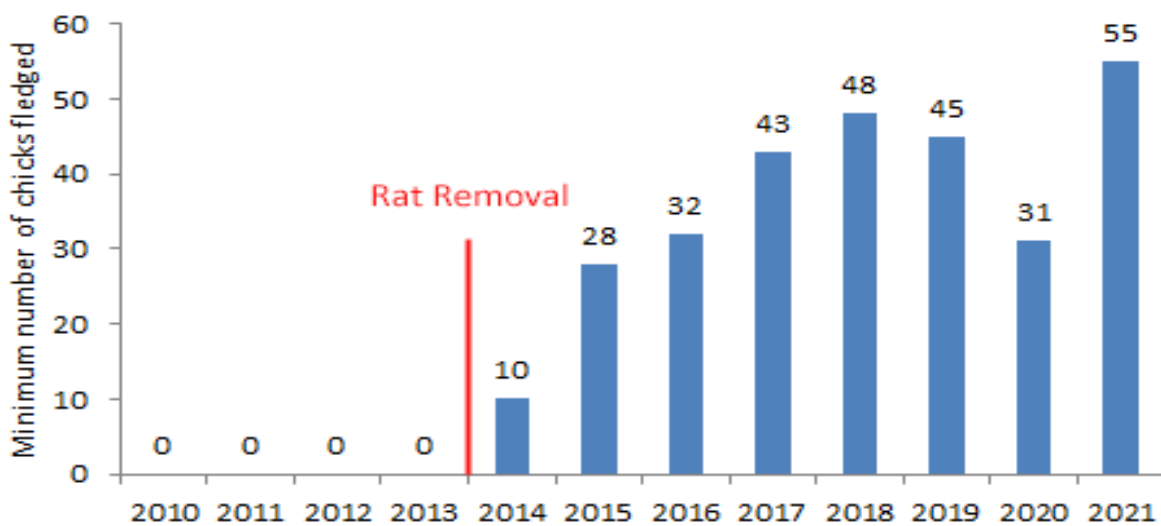
Breeding Success

Without direct access to the nest chamber through an inspection hatch it is not possible to get an accurate measure of breeding success for Manx shearwaters. Such inspection hatches are used at many shearwater colonies around the UK. However, since 2013, evening checks in August and September have been employed across St Agnes and Gugh to get an indication of breeding success for the shearwaters. This relies on the 'star-gazing' behaviour of chicks, where in the last 10 days or so before fledging the young birds venture outside their burrow entrances under cover of darkness to stretch their wings and explore for a few hours after night falls (Brooke 1990).

In 2021, evening checks between August and late-September recorded a record 55 star-gazing chicks across St Agnes and Gugh (28 on St Agnes and 27 on Gugh), translating to a breeding success of between 0.59 and 0.77 chicks per Apparently Occupied Burrow. This is similar to the breeding success on Lundy after rat removal (0.62 to 0.80 chicks per pair) and the 1986-2019 national average of 0.65 (JNCC 2019.)

Star-gazing behaviour is very much dependent on the amount of ambient light (Brooke 1990). Dark nights with thick cloud and/or fog are ideal and result in the highest counts. Conversely when the moon is bright and skies clear, chicks rarely venture out, as the ambient light can be enough to allow nocturnal gull predation. When 'bright' nights coincide with the star-gazing and fledging window for the shearwater chicks, it appears that they do not spend much time outside the burrow at all and are more likely to leave directly from the burrow to the water. The lower number of chicks encountered in 2020 served to highlight this flaw in the 'stargazer count' method, as the peak fledging period (late August/ early September) coincided with a full moon and a long string of clear skies which was likely to have led to a reduced number of chicks encountered on the ground. Discussions with Greg Morgan, Warden on Ramsey Island, revealed that in 2020, although his chick ringing totals (from ringing chicks found on the ground after dark) were well down on the usual numbers, the shearwater breeding success, recorded from study burrows with direct access, was no lower than average.

Manx shearwater breeding success St Agnes & Gugh



Manx shearwaters elsewhere across the islands

In 2015/16 the total number of Manx shearwaters breeding across the Isles of Scilly was estimated at 523 pairs, with many of these birds attempting to breed at sites with continued rat presence. A number of evening checks were made at two of these sites, Shipman Head, Bryher and Peninnis, St Mary's in August and September 2021. As in previous years, no fledglings were recorded and a nocturnally active rat was sighted around the burrows at Shipman Head. In addition, evidence of a potentially predated bird (copious feathers in the burrow entrance) was found at a burrow at Giants Castle, St Mary's. Although the occasional chick may survive from these nesting attempts (as seen in 2019 at Peninnis), it seems likely that these populations are only being maintained at a low level by immigration, either from other rat free islands in Scilly or further afield.



A star-gazing Manx shearwater chick viewed with red light to reduce disturbance, St Agnes.

Storm petrel settlement and productivity

[2015/16 full SPA count: 1,335 AOSs on 14 islands, Stable; BOCC Amber Listed]

Since the return of storm petrels as a breeding bird to St Agnes & Gugh in 2015 following rat removal, numbers have been increasing with breeding birds spreading into new areas. Storm petrels will breed in a wide range of habitats including in boulder beaches, rock crevices and underground burrows as well as under vegetation. It is not possible to survey all potential breeding habitat across the two islands as this area is too extensive and only a sample survey is completed each year (see map). Since 2019 there has been an issue with cat predation of adult storm petrels and this was encountered again in 2021 with as many as 17 adult birds killed across three relatively wide-ranging sites – Troytown in St Agnes, Burnt Island & Gugh. Trail cameras were deployed at these sites from June to early October, but no useful footage was

obtained of the cat. Efforts to establish the identity of the cat (from video obtained in 2019 and 2020) and to work with St Agnes residents around the issues of responsible cat ownership are ongoing.

Despite the continued predation issue, there was evidence of successful breeding at a number of sites. Storm petrel chicks do not stargaze like shearwater fledglings, but they do call noisily from their burrows towards the end of their fledgling period allowing confirmation of successful breeding. Fledglings have been heard cheeping and whistling from beneath the rocks on calm dark nights each year in late August and through September since 2015. In 2021 a total of 11 chicks were heard (4 on St Agnes, 7 on Gugh). This included two chicks heard at a new breeding site in the extensive boulder beach at Pedney Brow, Wingletang.



Known storm petrel breeding areas on St Agnes and Gugh in 2021

Lesser black-backed gull settlement and productivity

[2015/16 full SPA count: 2,485 AOSs on 30 islands, 26% decline since 2006; BOCC Amber Listed]

The number of lesser black-backed gulls breeding in Scilly has fallen dramatically in recent years, with a decline of 26% between 2006 and 2015 to just under 2,500 breeding pairs (Heaney & St Pierre 2017). The majority of the birds in Scilly now breed in three main sub-colonies; Samson, St Helen's and Gugh. Since 2012 the numbers and productivity at the Gugh sub-colony, where breeding numbers have halved since 2006, have been recorded annually (see table 3).

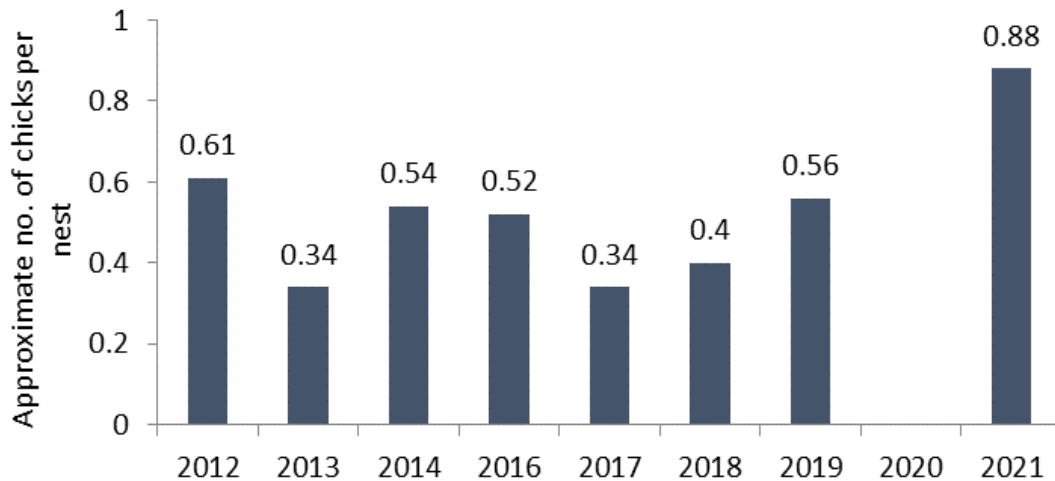
Fledging success, estimated by observing nests from a vantage point above the colony, indicated a particularly high breeding success in 2021. This is in line with other Celtic Sea colonies at Skokholm, Skomer and Bardsey which all recorded significantly higher than average productivity for lesser black-backed gull in 2021 (Seabird Group 2021.)

Table 3. Lesser black-backed gull productivity on Gugh

Year	LBBG	Productivity Estimates
2012	361	Approx. 180 chicks fledged from 262 nests South Col top colony (0.69 ch/pr); minimum 19 chicks fledged from 65 nests lower rocks colony Cuckold's Carn (0.29 ch/pr).
2013	418	Minimum 103 chicks fledged from 355 nests South Col top colony (0.29 ch/pr)*; minimum 32 chicks fledged from 48 nests lower rocks colony Cuckold's Carn (0.67 ch/pr).
2014	411	Approx. 185 chicks fledged from 325 nests South Col top colony (0.57 ch/pr); minimum 28 chicks fledged from 70 nests lower rocks colony Cuckold's Carn (0.40 ch/pr)
2016	400	Approx. 182 chicks fledged from 359 nests South Col top colony (0.51 ch/pr); minimum 24 chicks fledged from 40 nests lower rocks colony Cuckold's Carn (0.60 ch/pr)
2017	296	Approx. 79 chicks fledged from 249 nests South Col top colony (0.32 ch/pr)*; maximum 21 chicks fledged from 44 nests lower rocks colony Cuckold's Carn (0.48 ch/pr)
2018	452	Approx. 147 chicks fledged from 384 nests South Col top colony (0.38 ch/pr); minimum 22 chicks fledged from 44 nests lower rocks colony Cuckold's Carn (0.50 ch/pr)
2019	422	Approx. 216 chicks fledged from 376 nests South Col top colony (0.58 ch/pr); minimum 17 chicks fledged from 40 nests lower rocks colony Cuckold's Carn (0.43 ch/pr)
2020	-	No count due to Covid, although 100+ chicks seen late July suggested a reasonably good season
2021	397	Approx. 232 chicks fledged from 263 nests South Col top colony (0.88 ch/pr); minimum 32 chicks fledged from 34 nests lower rocks colony Cuckold's Carn (0.94 ch/pr)

* High vegetation means this count was probably an under-estimate

Lesser black-backed gull productivity on Gugh



Use of Drone technology to survey gulls

The method used for counting gull nests across Gugh (and for all gull nests across Scilly) is the traditional 'walk-through'; where a line of observers a metre or two apart systematically cover all the ground in the colony and count the active nests (fully formed nests with or without eggs). Although effective, it is a relatively invasive technique that creates quite a bit of temporary disturbance and there is potential for error with missed or double counted nests. In addition to this, nests at a number of sites in Scilly are found around clear patches or rocks deep within thick brambly vegetation, making them near-on impossible to access and count.



Gareth Tibbs piloting the Mavic Pro 2 drone on Samson

In the last 10 years, the use of UAVs (Unpiloted Aerial Vehicles) or drones has increased markedly in ecological studies, particularly for counting gulls and terns. For counting the gulls on Gugh, drones if used carefully, appear to offer two main advantages;

- accessing nests deep in vegetation
- a considerable reduction in the amount of disturbance to breeding birds.

As flying drones involves a good degree of skill and knowledge of regulations (e.g., in Scilly drone use is restricted over much of the islands by the Civil Aviation Authority) and the drones themselves are expensive, it was decided to employ a local drone pilot – Gareth Tibbs from Bryher – to help with the survey in 2021.

Rush *et al.* (2018) presented a study using drones to produce high resolution images for later analysis of lesser black backed gull colonies on Skokholm Island (1,400 breeding pairs). We were informed by their protocol and used a Mavic 2 Pro drone as follows:

- A smooth flyover at 40 m above the sub-colony from a take-off site approximately 20m to the side of the sub-colony, allowing the birds to become comfortable with the UAV – rapid changes in altitude or direction can be perceived as predatory behaviour and cause alarm.
- The altitude of the UAV was lowered to 25-30m whilst in motion to the side of the sub-colony.
- A transect was flown at a speed of 4mph providing image overlap of approximately 20% over the sub-colony with images captured at 2 second intervals to ensure a similar overlap between images. This resulted in @630 high resolution images.

The high-resolution images collected were then uploaded onto *Dronedeploy.com* which meshed them together to produce an orthomosaic of the sub-colony – effectively a large top-down image of the whole site for analysis.

This method was used in early June on both Gugh and Samson to look at breeding numbers of lesser black-backed and herring gulls respectively, and again in mid-July to see if it was suitable for counting the number of chicks.

Reaction to the drone

The surveys were carried out with a two-person team – Gareth concentrating on the drone and survey route/ coverage and myself observing the responses of birds to the drone presence. On Gugh the drone survey proved very useful. The birds were unconcerned by the presence of the drone – we briefly tried flying at 20m height which started to garner reaction so returned to 25-30m.

However, on Samson the gulls (both herring and lesser black-backed) and oystercatchers were very aware of the drone presence. Even at 70m a couple of gulls and an oystercatcher continued to follow the drone and flew close enough for concern for the welfare of the birds and the drone. A later attempt with a smaller, quieter drone was more successful but at the height currently needed the footage was not as easy to analyse as that obtained on Gugh.

Analysis of footage

The orthomosaic proved very good for locating birds, but as was expected from conversations with other researchers, it was not always easy to distinguish birds sitting on nests from 'off-

duty' birds just standing in the colony (see below) resulting in an inflated count. However, the drone footage was particularly useful in locating nests deep in vegetation and at inaccessible sites.



Overview of most of the 'saddle colony' on Gugh, with birds circled on Dronedeploy.com (poor 'screen-grab' reproduction image quality as the free version of *Dronedeploy* does not allow saving)



Zoomed-in image to show two lesser black-backed gulls sitting on nests



Zoomed-in image to show nesting herring and lessers and a presumed standing herring (top bird).

Drone footage has been used to record productivity in gulls e.g., for glaucous and Iceland gulls where using UAVs recorded as much as 50% more chicks than ground counts (Brisson-Curadeau *et al.* 2017). The photo below was taken on Gugh in mid-July and shows the potential for counting lesser black-backed gull chicks. However, the camouflaged colouring of the gull chicks does make them hard to spot.



Gugh lesser black-backed gull colony 21st July 2021 with large chicks circled.

Herring gull settlement and productivity

[2015/16 full SPA count: 556 AONs on 47 islands, 22% decline since 2006; BOCC Red Listed]

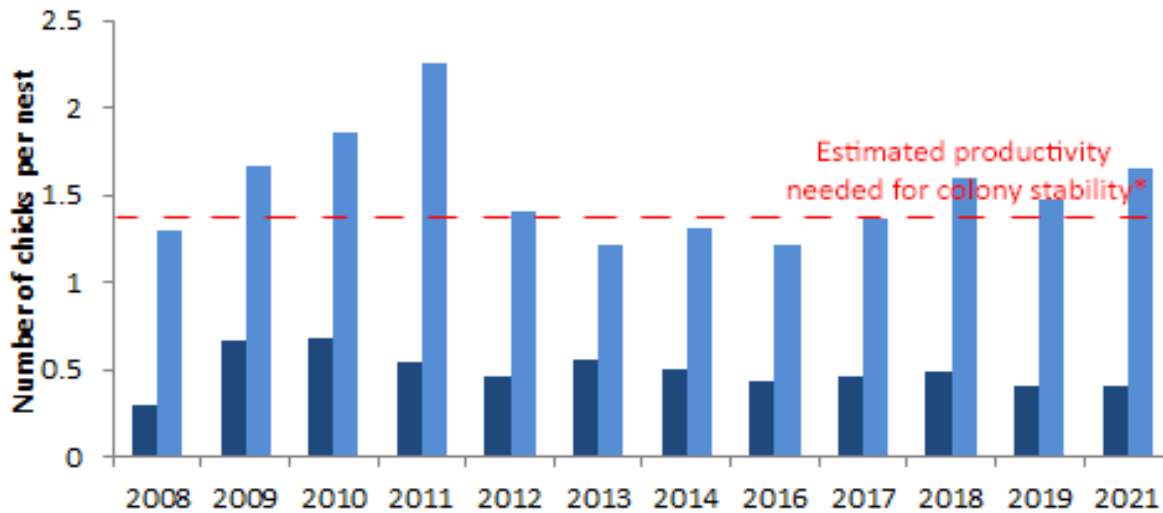
In 2015 herring gulls were red-listed as a species of conservation concern due to recent declines in numbers nationally (estimated 47% loss of abundance, natural nesters only, 2000-2018, JNCC 2019). Breeding numbers across Scilly of this species have also been falling at a rapid rate with a decline of 22% between 2006 and 2015/6 to just 556 pairs (Heaney & St Pierre 2017). Since 2008 the productivity of herring gulls at three sub-colonies on St Mary's, Tresco (now deserted) and Samson has been recorded by observing minimum fledging success at mapped nests. The results are presented below.

Over the years of this study the small roof-top colony in Hugh Town, which presumably relies on more anthropogenic food sources than those on Samson, has fared consistently better. Whilst the absolute number of birds nesting on the study beaches on Samson has declined, the number of birds in town, although low, has been increasing. The fledging success in Hugh Town is also substantially higher and well above that needed for colony stability, thus potentially fuelling growth. Unfortunately, the gulls nesting in town are not universally welcomed and the amount of suitable undisturbed roof space is very limited.

Table 4. Herring gull productivity estimates

Year	Gimble Porth	Samson	Hugh Town
2008	0.48 (n=50)	0.30 (n=84)	1.29 (n=7)
2009	0 (n=41)	0.66 (n=73)	1.67 (n=6)
2010	0 (n=17)	0.68 (n=63)	1.86 (n=7)
2011	0 (n=9)	0.54 (n=71)	2.25 (n=8)
2012	0 (n= 3)	0.46 (n=56)	1.4 (n= 10)
2013	0 (n=2)	0.56 (n=55)	1.22 (n=9)
2014	Deserted	0.50 (n=34)	1.31 (n=13)
2015	Deserted	(n=56)	(n=14)
2016	Deserted	0.43 (n=53)	1.22 (n=9)
2017	Deserted	0.46 (n=44)	1.44 (n=16)
2018	Deserted	0.49 (n=37)	1.60 (n=20)
2019	Deserted	0.40 (n=38)	1.47 (n=19)
2021	Deserted	0.41 (n=32)	1.65 (n=17)

Herring gull productivity on Samson & Hugh Town



KEY: Samson dark blue; Hugh Town light blue. No productivity recorded in 2015 or 2020.

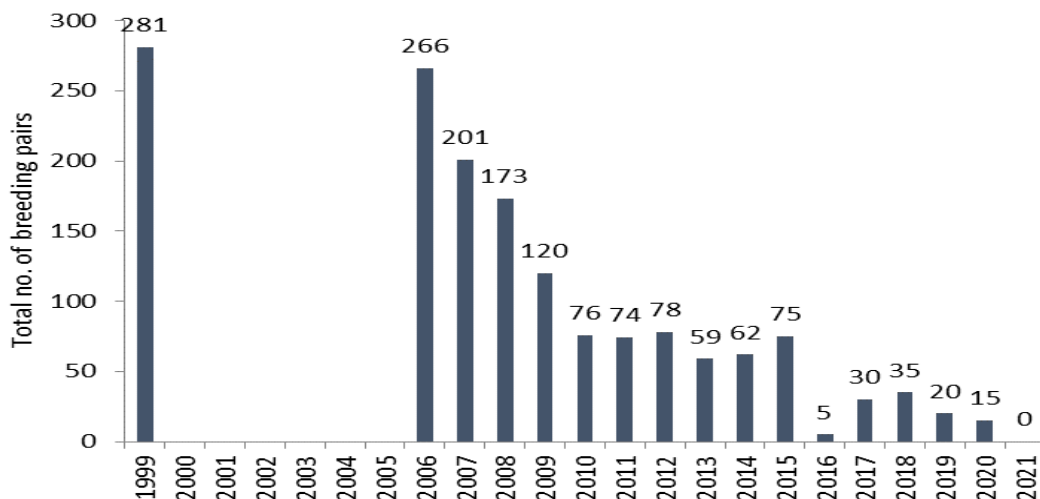
*Cook and Robinson (2010) estimate that an average productivity of 1.3-1.5 chicks per pair per year is needed for colony stability.

Kittiwakes across Scilly

[2015/16 full SPA count: 75 AOSs on 1 island, Rapid decline; BOCC Red Listed]

All kittiwake sub-colonies across Scilly have been counted annually since 2006. Over this period dramatic declines have been recorded, with the loss of 5 sub-colonies and total breeding failure in 9 of the last 16 years. In the last 8 years only one sub-colony site has been occupied by all of the remaining birds (below the Turk's Head at St Agnes 2014-16 and then Gugh 2017-20). At no time in this study has the productivity of the kittiwakes in Scilly approached the level of 1.5 chicks per pair per year, estimated to be needed for colony stability (Cook & Robinson 2010). In 2021 although a small number of kittiwake pairs showed some initial interest in the low cliff site on the east of Gugh, no subsequent breeding attempts were recorded.

Kittiwake breeding numbers in Scilly



* Breeding numbers not recorded in the years 2000 to 2005.

Fulmar productivity

[2015/16 full SPA count: 287 AOSs on 18 islands, Stable; BOCC Amber Listed]

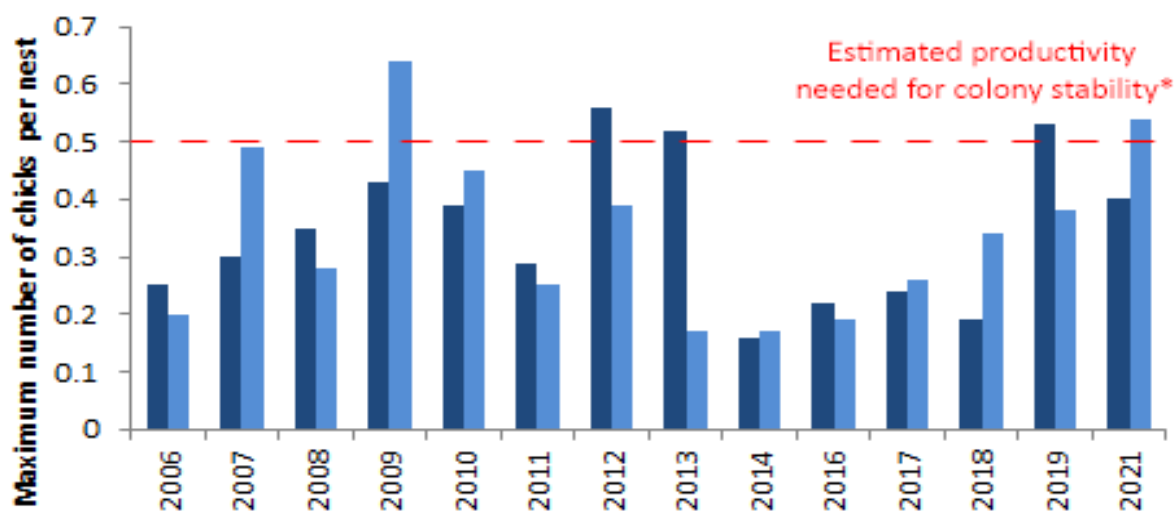
Since 2006 two of the main discrete cliff-side fulmar sub-colonies, those on Menawethan and the Daymark, St Martin's, have been monitored from the sea. The numbers settling at the two sites have been fairly consistent over this time but the fledging success quite variable (see Table 5). In general, productivity has been lower than the level needed to sustain the population (Cook & Robinson 2010) and this will go some way to explaining the recent slowing of population growth across Scilly. However, there is some evidence of a reversal of this trend with fledging success starting to increase again from an overall low in 2014. Across the UK the mean productivity recorded for fulmars between 1986 and 2008 was 0.39 chicks per pair per year, declining at a rate of 0.005 ch/pr/yr.

Table 5. Fulmar productivity estimates

	Menawethan	Daymark	Total
2006	0.25 (<i>n</i> = 44)	0.20 (<i>n</i> = 46)	90
2007	0.30 (<i>n</i> = 41)	0.49 (<i>n</i> = 45)	86
2008	0.35 (<i>n</i> = 37)	0.28 (<i>n</i> = 46)	83
2009	0.43 (<i>n</i> = 33)	0.64 (<i>n</i> = 36)	69
2010	0.39 (<i>n</i> = 30)	0.45 (<i>n</i> = 51)	81
2011	0.29 (<i>n</i> = 24)	0.25 (<i>n</i> = 49)	73
2012	0.56 (<i>n</i> = 25)	0.39 (<i>n</i> = 59)	84
2013	0.52 (<i>n</i> = 27)	0.17 (<i>n</i> = 54)	81
2014	0.16 (<i>n</i> = 44)	0.17 (<i>n</i> = 52)	96
2015*	(<i>n</i> = 43)	(<i>n</i> = 46)	89
2016	0.22 (<i>n</i> = 45)	0.19 (<i>n</i> = 57)	102
2017	0.24 (<i>n</i> = 34)	0.26 (<i>n</i> = 54)	98
2018	0.19 (<i>n</i> = 33)	0.34 (<i>n</i> = 50)	83
2019	0.53 (<i>n</i> = 34)	0.38 (<i>n</i> = 53)	87
2020	-	-	-
2021	0.40 (<i>n</i> = 43)	0.54 (<i>n</i> = 46)	87

*Productivity not recorded in 2015

Fulmar productivity in Scilly



KEY: Dark blue Menawethan, light blue Daymark.

*Cook and Robinson (2010) estimate that an average productivity of 0.5 chicks per pair per year is needed for colony stability in fulmars. Productivity not recorded in 2015 or 2020.

Common tern breeding numbers and productivity

[2015/16 full SPA count: 12 AONs on 2 islands, Precipitous decline; BOCC Amber Listed]

Following a maximum count of 210 breeding pairs in 1983, the number of common terns breeding in Scilly has been in rapid decline (Heaney & St Pierre 2017). Alongside this steep decline in numbers of terns returning to breed each year, the birds have suffered repeated low success or total breeding failure. In a number of seasons this has been due to their repeated choice of the low-lying Green Island, where high tides often swamp the colony resulting in egg and chick loss.

In recent years the terns have been very late to return to the islands and show interest in breeding, with hatching observed well into July in both 2016 and 2017. Although in both these years a few chicks fledged, numbers were low and the lateness likely to adversely affect post-fledging survival. After a failure to breed in Scilly at all in 2019 and 2020, a small number of birds settled on Annet in 2021. Again, the terns arrived late to the islands, with 18 pairs laying an average clutch size of 1.72 eggs on the south end of Annet in mid to late June (UK generally mid-May.) Three fledglings were recorded later in mid-August giving a minimum of 0.17 chicks fledged per pair.

Common tern breeding numbers in Scilly

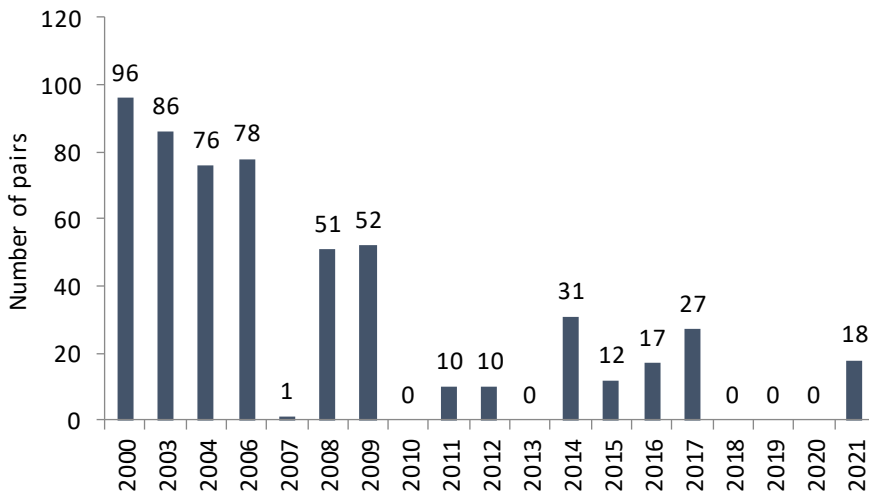


Table 6. Common tern productivity estimates

Year	Productivity	Notes
2003	0.43 ($n = 86$)	Appletree Bank Tresco, Samson and Annet
2004	0.59 ($n = 76$)	Majority of nests on North Hill, Samson
2006	0 ($n = 78$)	Young inundated by storm tide, Green Island
2007	0 ($n = 1$)	Only one breeding attempt recorded, Annet
2008	0.26 ($n = 51$)	Green Is. 41 nests; Peasehopper 10 nests
2009	0.39 ($n = 52$)	Green Is. 51 nests; Annet 1 nest
2010	0 ($n = 0$)	Birds settling on Green Is. but site abandoned before laying
2011	0 ($n = 10+$)	Late settlement, then Green Is. site inundated by storm tide
2012	0 ($n \leq 10$)	Late settlement, some eggs lost to storm tide Green Island
2013	0	No breeding attempts recorded
2014	0.42 ($n = 31$)	3 chicks from 12 nests Green Is.; 10 from 19 North Hill Samson
2015	0 ($n = 12$)	2 Annet; 10 Samson (failed early egg stage)
2016	0.41 ($n = 17$)	South end Annet very late settling; also 3 newly fledged chicks seen Merrick Island
2017	0.11 ($n = 27$)	South end Annet extremely late settling again
2018	0	Very few common terns returned to Scilly at all in 2018; 10 or so birds showed some interest in the South end Annet again in late May but no eggs were found.
2019	0	≤ 15 pairs appeared to settle and courtship feed on the western rocks in late June, but no breeding attempts confirmed
2020		Reports of common terns (<10 birds) settling on Rosevean – 2 birds seen but no sign of nests or food carrying mid-July
2021	0.17 ($n = 18$)	South end Annet; extremely late settling again



Common tern nest with egg and chick on Annet, June 2021

Annual count of breeding seabirds on Annet

(One of 7 SSSIs in Scilly listed specifically for its seabird interest features)

A count of the seabirds breeding on Annet has been made in most years since 2000 (see Table 7 – no counts were made in 2001, 2005 or 2020). This annual count concentrates mainly on the numbers of gulls and shags. Oystercatchers and ringed plovers are counted, and more recently burrow nesters have been included – puffins since 2018 and study sample areas for storm petrels and Manx shearwaters since 2015 and 2018 respectively.

These regular counts document an overall decline in the number of shags nesting on Annet which is mirrored across the rest of the islands (Heaney & St Pierre 2017). However, data from the last few years suggest a slight reversal of this trend. As elsewhere the number of small gulls has declined. In particular, the sub-colony of lesser black-backed gulls which numbered 517 in 2000 is now deserted. The number of great black-backed gulls, although high as a percentage of the overall assemblage on Annet, is still less than half the peak (of around 400 pairs) recorded for this species on the island before they were controlled by JNCC in the late 1970s.

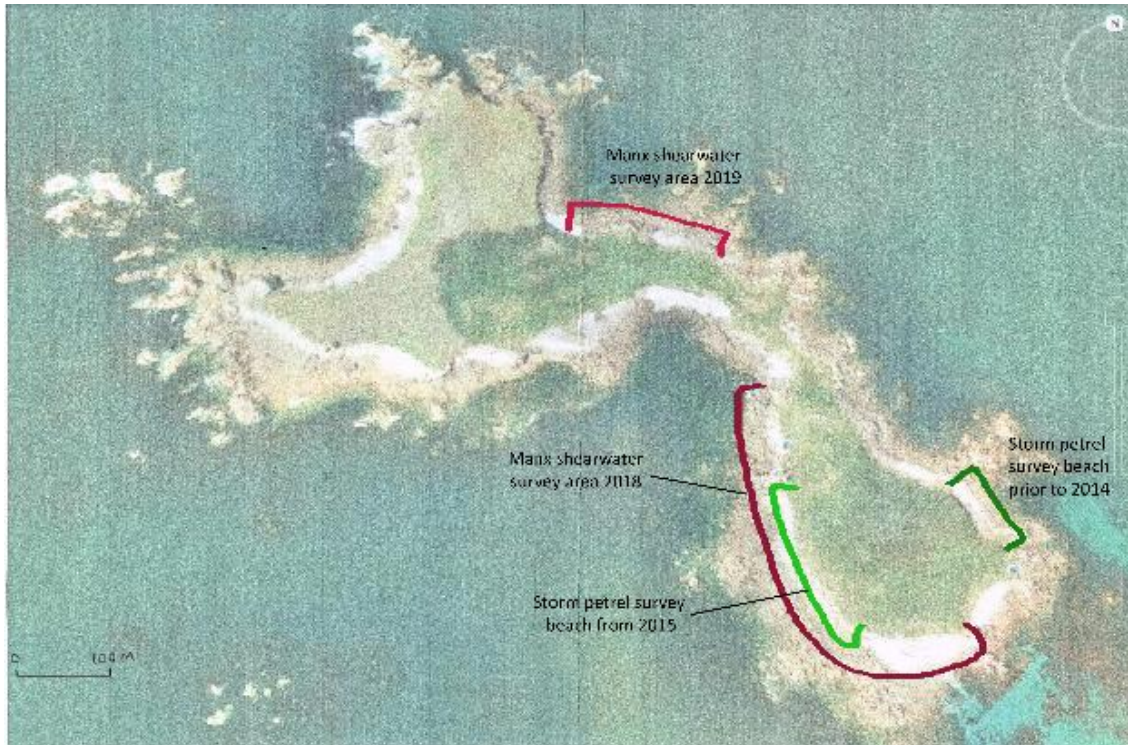
Table 7. Breeding seabirds on Annet; a dash indicates that no count was made.

Year	SH	GBBG	LBBG	HG	RAZ	FUL	COT	SP*	MX*	PUF	OYC	RPL
2000	209	137	517	42	4	21	1	938	123	47	-	-
2001	-	-	-	-	-	-	-	-	-	-	-	-
2002	-	171	215	7	4	-	-	-	-	-	-	-
2003	150	164	18	17	0	45	0	-	-	-	-	-
2004	159	197	7	32	2	44	0	-	-	-	5	0
2005	-	-	-	-	-	-	-	-	-	-	-	-
2006	177	187	281	24	4	37	0	788	89	50	-	-
2007	140	88	0	5	1	37	0	-	-	-	5	0
2008	164	47	(5)	4	3	48	0	-	-	-	6	0
2009	154	168	54	7	7	43	0	-	-	-	6	0
2010	198	213	76	11	2	40	0	-	-	-	7	1
2011	115	180	27	5	4	37	0	-	-	-	4	2
2012	107	177	32	8	2	49	0	-	-	-	-	-
2013	99	208	6	4	1	36	0	-	-	-	5	0
2014	96	205	10	5	1	38	0	-	-	-	9	1
2015	85	235	1	20	5	57	2	778	229	31	6	0
2016	86	215	1	16	6	41	14	(106)	-	-	4	1
2017	74	222	7	12	5	41	27	(132)	-	-	7	1
2018	81	170	6	19	0	46	0	(175)	(30)	43	8	0
2019	103	199	19	10	2	46	0	(338)	(30)	42	4	0
2020	-	-	-	-	-	-	-	-	-	-	-	-
2021	106	184	7	8	1	39	18	-	(29)	45	1	0

*Counts in brackets represent only a sample of the total breeding population on Annet.

Manx shearwater sample survey

An initial sample area for Manx shearwaters (to include both cairn, grass and thrift habitat) between Carn Windlass and South Carn was selected and surveyed in 2018. However, in 2019 a peregrine pair, that had previously bred out at Minmanueth, raised a single chick at ground level in the rocks at Carn Windless. Although permission was sought and granted from Natural England to complete the planned annual counts, the shearwater survey area selected in 2018 had to be abandoned in order to keep disturbance of the breeding falcons to a minimum. In 2019 an alternative area was selected running along the coast and 10m inland from just North of the Neck to the midpoint of North East Porth (see map below). This new sample site was surveyed in 2021 producing an estimate of 29 apparently occupied burrows (27 replies x 1.08). It is hoped that the new site can continue to be surveyed in subsequent years without adversely impacting the peregrines should they chose to nest at Carn Windlass again in future years (no nesting attempt was recorded in 2021 on Annet).



Manx shearwater and storm petrel sample survey areas, Annet

Storm petrel sample survey

Between 2010 and 2014 the number of Apparently Occupied Sites at a study beach between Smith’s Carn and Minmow on the south end of Annet was recorded annually using diurnal tape-playback. Unfortunately, this boulder beach was totally destroyed by storms in February 2014. A new study beach running between South Carn and Carn Windlass was identified in 2016 (see map above) and the results presented in Table 8 below suggest a significant and sustained increase in storm petrel numbers on Annet.

No count was made in 2020. In 2021 the late presence of tern chicks on the south end of the island meant that we could not count the usual survey beach. Instead, the Manx shearwater survey area identified in 2019 was counted and 35 replies were obtained, giving an estimate of 100 apparently occupied sites. More replies were elicited from above the boulder beach than expected, with a good number of birds nesting under rock crevices and in vegetation.

Table 8. Storm petrel numbers at Annet study beach

Year	Number AOSs	Notes
2000	109 (±)	38 responses x 2.86
2006	87	31 responses x 2.86
2015	92	32 responses x 2.86
2016	106	37 responses x 2.86
2017	132	46 responses x 2.86
2018	175	61 responses x 2.86
2019	338	118 responses x 2.86

Discussion

The productivity monitoring and breeding numbers presented in this report show mixed fortunes for the seabirds of Scilly. A number of complex and in many cases inter-related factors are likely to be contributing to the breeding successes and failures recorded. The number of burrow nesters on St Agnes and Gugh continues to increase year on year since rat removal; spreading to new breeding areas and with the highest number of fledging chicks to date recorded there in 2021. There is evidence that fulmars may also have benefited from rat removal on St Agnes and this should be investigated further in 2022. The fulmar and herring gull sub-colonies studied elsewhere in the islands this year appear to have had a relatively productive season, as did the lesser black-backed gulls studied on Gugh. There were more oystercatchers recorded breeding there than in previous years too (with 7 active nests around Drognose bay on Gugh alone in mid-June).

These results suggest that 2021 may have been a year of relatively good food supply. This is supported by discrete 'bait balls' and associated feeding flurries being a very apparent feature of June and July in the islands. Cetacean numbers also seemed high. However, despite a number of kittiwakes being present around the islands in early summer, they failed to breed. Common terns bred for the first time in 4 years, but were late to settle and still relatively low in numbers.

Manx shearwaters

Numerous studies have documented the overwhelmingly positive effect that clearance of rats from islands has on burrow nesting seabirds. The maintenance of rat free status on St Agnes and Gugh continues to bring substantial benefits for seabird conservation in Scilly. The increase in numbers here mean that it is now possible to conduct a season and site-specific calibration survey. Initial results suggest that the correction factor which has been used for all shearwater surveys in Scilly is too low, resulting in a significant underestimation of colony size. It will be important to repeat the calibration survey in 2022, with refinement and standardisation of methods for diurnal playback survey calibration allowing greater accuracy in estimating population size and comparing counts between sites.

In 2021 I noted a number of new burrows being dug by the shearwaters, with new areas being colonised. In recent years a number of undamaged eggs have been encountered outside burrows from which birds replied, suggesting that the previous owners had been ousted. The calibration study found that just over 50% of the apparently suitable burrows surveyed contained active nests (on Lundy the figure was only 23%, Booker *et al.* 2019.) With rabbits as well as recruiting shearwaters competing for burrows and a number of sub-colony areas being located in areas with hard ram substrate (e.g., Castella Down and Jogging Rock) it seems likely that completion for burrows is significant and increasing.

Provision of nest boxes for shearwaters on St Agnes & Gugh could increase habitat for the birds. As there is believed to be a high level of competition, this means that they are likely to be readily occupied. Artificial burrow and nest boxes could allow access to the nest chamber which opens up a whole host of exciting options. As well as directly recording nest success, remote cameras could be used to follow the nesting attempts, and for public engagement. Chicks and adults could be ringed allowing the recording of individual nesting success over successive seasons. With the typical age at first breeding of Manx shearwaters at six years (Brooke 1990), it is now possible that 'home-grown' birds have already returned to breed on Agnes and Gugh.

Ringling chicks and reading rings of adults in nest boxes brings the very real possibility of recording our first 'homegrown' youngster known to return and breed.

The 2015/16 full SPA survey revealed that up to a third of shearwaters that breed in Scilly do so at sites with rat presence. The continued records of low to no breeding success recorded on Bryher and St Mary's contrast starkly to the results seen on St Agnes and Gugh. With so many birds in Scilly still suffering the impact of rat predation, the impetus for extending the Seabird Recovery work in Scilly to Bryher, Tresco, St Martin's and their associated uninhabited islands, is strong.

Drone work

The results from the drone surveys this season on Samson and Gugh were very promising. Drone technology is developing fast and new improved models are released all the time. In time for the 2022 season, Gareth plans to upgrade to a new model with 7x higher zoom. This will allow much clearer images allowing easier separation of birds on the nest and those loafing nearby. It will also mean that it should still be possible to get good images at the greater heights needed to avoid disturbance on Samson. The cost of the software currently used to orthorectify the images (*dronedeploy.com*) is another important consideration, although as the technology moves forward alternatives may become available.

Recommendations

The current Isles of Scilly Seabird Conservation Strategy runs from 2018-23 and looks at ways to address the declines we have seen in seabirds across the islands. Strategic action points and objectives will be reviewed and developed in partnership as part of this work programme over the next few years, leading to the development of a new strategy for 2024-28.

The following recommendations aim to form part of this review and development process for future seabird work:

- Response rate calibration survey should be repeated for Manx shearwaters on St Agnes and Gugh in 2022
- Further use of drones to count gulls on Gugh and Samson, including exploring other methods for processing imagery
- A full SPA count is due again (intended to be undertaken every 6 years, last conducted in 2015/16)
- Fixed cameras have proved invaluable in recording causes of nest failure in kittiwakes on Gugh (peregrine predation in 2019) and their use should be further investigated for recording provisioning and success for gulls and terns (cameras mounted on a pole) and using motion sensor triggers on Samson and Annet for shags and on St Helens and north-east Par Annet for puffins. In particular lesser black-backed gulls and shags are of high national priority for productivity monitoring.
- A visit to another seabird colony (e.g., Skomer) for a few days early in the breeding season, to collaborate, share knowledge and learn new monitoring techniques e.g., set up of inspection burrows and artificial nest box design.
- As the number of birds breeding on St Agnes and Gugh increase there is an argument to start ringling star-gazing chicks (as is done at most other colonies where they are studied)?

- Provision of nest boxes for shearwaters on St Agnes & Gugh could allow access to the nest chamber to directly record nest success. Remote cameras could be used to follow the nesting attempt and for public engagement. This would also enable rings on adults to be read, allowing the possibility of recording our first 'homegrown' youngster known to return and breed in future years. The best areas to put them will need identified.
- Review of historical vegetation control and management in Scilly (particularly Samson, St Helen's, Tean, Norwethel, Eastern Isles and Annet), providing a strategic overview of vegetation clearance for seabird breeding
- Invasive Mammal Predator impacts
 - Identify the cat predating storm petrels on St Agnes and work with the owners and the wider community to find a solution
 - Keep up the pressure for rat removal future islands – still the most impactful thing we can do for seabirds in Scilly
 - St Agnes & Gugh – work with Biosecurity For LIFE on vigilance and awareness to guard against re-incursion.
 - Islands currently of highest priority but believed to be rat free and unlikely to suffer incursion are the Western & Norrard Rocks, Annet and Round Island. Periodic monitoring is still needed on these sites to maintain vigilance.
 - Monitoring of productivity for fulmars on St Agnes (rat free) to compare with the St Martins and Eastern Isles sub-colonies currently monitored (rats present)
- Could fenceless grazing on St Agnes help cows avoid the more sensitive coastal edge strip which is quite compacted, where burrows are and where cows pick up most of the plastic waste that can kill them?
- GPS tracking – where do our seabirds feed?
- Consideration of Scilly as a key Celtic Sea seabird site to be included in the Seabird Monitoring Programme (Current study sites Canna, Isle of May, Fair Isle, Skomer, Grampian, Orkney & St Kilda.)
- Devising a recreational management plan, which will investigate visitor impacts and identify ways to avoid or mitigate these impacts.
- Further development of key seabird conservation priorities and joint communications strategy.

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